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AD873565

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5 June 1970

Materiel Test Procedure 6-4-006
U. S. Army Arctic Test Center

U. S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

ARCTIC ENVIRONMENTAL TEST OF TACTICAL WIRE COMMUNICATIONS EQUIPMENT

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide a means of evaluating the performance, safety, human factors engineering, maintainability and reliability aspects of Tactical Wire Communications Equipment tested under arctic winter environmental conditions.

2. BACKGROUND

Tactical Wire Communications Equipment intended for use by the Army must be designed for use under varied extreme environmental conditions. Environmental test must be conducted to determine if the test items perform satisfactorily under this extreme environmental conditions. The tests and the conditions under which they are conducted must assure the fighting man of a complete piece of equipment capable of top performance in the intensified usage of the combat environment; a piece of equipment in which he can have complete confidence.

Testing in a natural arctic winter environment is used to substantiate or supplement data obtained from simulated tests conducted during the engineer design and engineering test phase. Testing in the arctic winter environment is generally not authorized until data from the simulated environmental tests provides reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the arctic

3. REQUIRED EQUIPMENT

- a. Arctic Winter Uniform as specified in MTP 10-4-500.
- b. 180-day maintenance package to support test items, plus (when possible) 100% replacement parts for parts known to be vulnerable to arctic conditions such as electronic parts and rubber and soft plastic parts.
- c. General and special tools and ancillary items required for assembly and maintenance of the test item.
- d. Maintenance facilities (organizational, direct and general support shops with qualified personnel).
- e. Support vehicles with drivers (wrecker on call).
- f. Support equipment for particular test item.
- g. Security area for crypto equipment.
- h. Ohmmeter.
- i. Other instrumentation peculiar to the item being tested.
- j. Weighing scales.
- k. Photographic support.
- l. Skis and snowshoes.

REFERENCES

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- A. AR 70-8, Human Factors and Social Sciences Research.
- B. AR 70-10, Test and Evaluation During Research and Development of Materiel.
- C. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
- D. AR 705-5, Army Research and Development.
- E. AR 750-6, Maintenance Support Planning.
- F. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.
- G. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- H. USATECOM Regulation 700-4, Reliability Program for USAMC Materiel.
- I. USATECOM Regulation 705-2, Documenting, Test Plans and Reports.
- J. USATECOM Regulation 750-15, Maintenance of Supplied and Equipment-Maintenance Portion of the Service Test.
- K. USAMC Regulation 385-12, Verification of Safety of Materiel During Testing.
- L. USAMC Regulation 385-224, AMC Safety Manual.
- M. USAMC Regulation 700-38, Correction of Defects Found During Materiel Life Cycle Testing.
- N. MTP 6-1-001, Testing Communications, Surveillance and Avionic Electronic Equipment.
- O. MTP 6-2-055, Communication Security Equipment.
- P. MTP 6-2-110, Handset, Telephone.
- Q. MTP 6-2-115, Handset (earphones).
- R. MTP 6-2-290, Terminals, Telegraph and Telephone.
- S. MTP 6-2-326, Wire and Cable.
- T. MTP 6-2-327, Cable Dispensers.
- U. MTP 6-2-329, Reeling Machines.
- V. MTP 6-2-507, Safety.
- W. MTP 6-2-520, Transportability of Communication, Surveillance and Electric Equipment.
- X. MTP 6-2-521, Engineering Intelligibility Test of Voice Communication Equipment.
- Y. MTP 6-2-530, Altitude and Temperature - Altitude Tests.
- Z. MTP 6-2-531, Temperature Tests.
- AA. MTP 6-2-532, Sunshine Test.
- AB. MTP 6-2-533, Rain Test.
- AC. MTP 6-2-534, Humidity Test.
- AD. MTP 6-2-535, Fungus Test.
- AE. MTP 6-2-536, Salt Fog Test.
- AF. MTP 6-2-537, Dust Tests.
- AG. MTP 6-2-538, Explosive Atmosphere Tests.
- AH. MTP 6-2-539, Immersion Tests.
- AI. MTP 6-2-540, Vibration Tests.
- AJ. MTP 6-2-541, Shock Tests.
- AK. MTP 6-3-170, Loudspeakers.
- AL. MTP 6-3-329, Reeling Machines.
- AM. MTP 6-3-504, Installation and Operation.
- AN. MTP 6-3-510, Transportability of Communication, Surveillance,

- and Electronic Equipment.
- AO. MTP 6-3-521, Operational Intelligibility Test of Voice Communication Equipment.
 - AP. MTP 6-4-001, Desert (Field) Environmental Test of Communication, Surveillance and Avionic Electronic Equipment.
 - AQ. MTP 6-4-003, Tropic Environmental Test of Communication, Surveillance and Avionic Electronic Equipment.
 - AR. MTP 10-4-500, Arctic Environmental Test, Preoperational Inspection, Physical Characteristics, Human Factors, Safety, and Maintenance.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP are designed to determine and evaluate the physical characteristics of tactical wire communication equipment in arctic environmental conditions and provide guidance for the conduct of arctic environmental testing of tactical wire communication equipment. Whenever possible 25% of the testing will be conducted at temperatures between 0°F and -25°F, 50% between -25°F and -50°F and 25% at temperatures below -50°F. Specific subtest to be performed include:

- a. Preoperational Inspection and Physical Characteristics
- b. Functional Suitability
- c. Durability
- d. Compatibility
- e. Human Factor Evaluation and Safety
- f. Maintenance Evaluation

5.2 LIMITATIONS

This MTP is limited to general procedures for Service Tests, Integrated Engineering and Service Tests. Confirmatory (Type I) Tests and Check Tests of Tactical Wire Communication Equipment performed under an arctic winter environment. This MTP applies to testing of field wire, telephones, switchboards, teletypewriters, reels, cables, crypto equipment and related equipment. Specific tests required by the test directive, or other requirements will be performed using this MTP as a guide.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Since arctic winter environmental tests are normally scheduled from October through March (6 months), ensure that the test items are delivered to the Arctic Test Center prior to 1 September allowing adequate time for inspection, repair, and replacement of all defective items. Any delay in the test schedule will be reported to TECOM headquarters and a revised schedule requested. The test schedule will reflect on estimate of net testing time required for each subtest.

b. When necessary to augment assigned personnel, ensure the availability of TDY personnel and their training to the degree that they are as proficient on the individual test items as the troops who will use the equipment. Assigned personnel will prepare the plan of test, supervise and conduct the test, gather test data, and report the results of the test.

c. Ensure that all test personnel are familiar with required technical and operational characteristics of the test item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC) and record the criteria in the test plan. A familiarization class will be given to all testing personnel, by the test officer, as required.

d. Ensure that all personnel receive New Equipment Training (NET) as referenced in paragraph 4F.

e. Review all instructional material issued with the test item(s) by manufacturer, contractor, or government agencies, as well as reports of previous tests conducted on the same type of equipment and familiarize all test personnel with such documents.

f. Select test equipment ideally having an accuracy 10 times greater than that of the specified tolerances of the function(s) to be measured.

g. Prepare record forms for systematic entry of data, chronology of tests, and analysis in final evaluation.

h. Prepare adequate safety precautions to provide safety for personnel and equipment (refer to MTP 6-2-507). Ensure that a Safety Release has been obtained prior to test conduct.

i. Outfit all personnel in appropriate arctic uniform as described in MTP 10-4-500.

j. Record the prevailing meteorological conditions during test conduct, to include:

- 1) Temperature
- 2) Humidity, relative or absolute
- 3) Atmospheric pressure
- 4) Precipitation
- 5) Solar Radiation
- 6) Frequency readings
- 7) Source of data

k. Upon notice of arrival of the test item(s) or the estimated time of arrival, select and schedule the use of testing sites, facilities and equipment as required by the applicable subtest and/or corresponding MTP.

6.2 TEST CONDUCT

- NOTE:
1. All testing, operation and servicing of the test equipment will be in accordance with instructions contained in the maintenance package. Errors within and necessary deviations from these instructions shall be recorded.
 2. Throughout the conduct of testing, a determination will be made of any unnecessary, costly or nice-to-have features that might be eliminated without adversely

affecting essential performance requirements, reliability, quality or safety.

3. The test items will be stored outdoors and exposed to the prevailing weather conditions, except for periods when indoor maintenance is required.
4. The test items will be operated under arctic winter conditions during temperatures ranging from 0°F to the lowest applicable ambient temperature when applicable. Appropriate meteorological and test data will be recorded during conduct of each subtest.
5. Subtests will be conducted concurrently with other subtest whenever possible for more efficient utilization of personnel and resources available and to minimize test time, and duplication of data.

6.2.1 Preoperational Inspection and Physical Characteristics

- a. Upon receipt, carefully inspect all test items and their shipping or packaging containers for completeness, damage, and general condition, in accordance with the applicable reference MTP's.
- b. Note and record the physical characteristics of the test item and/or any components thereof in all obtainable configurations.
- c. Record the nomenclature and manufacturers name of the test item.
- d. Take photographs of the test item, if required.
- e. Note and record all discrepancies, corrective action necessary, and other information pertinent to the discrepancies.
- f. Ensure the test item is properly assembled, secured, cleaned, and correctly adjusted. Record any necessary corrective action.

6.2.2 Functional Suitability

NOTE: All test items shall be cold soaked for a minimum of 24 hours at ambient air temperatures in the temperature range in which the test is to be conducted. 25% of all tests will be conducted between 0°F and -25°F, 50% between -25°F and -50°F, and 25% will be conducted at temperatures below -50°F.

6.2.2.1 Field Wire and Cable

- a. Lay wire and cable over various terrain (hills, woods, tundra, rivers, river bottoms, rocky cliffs, etc.). They should be laid by personnel on foot, in wheeled vehicles, in tracked vehicles, in fixed and rotary winged aircraft and any other appropriate way. Wire or cables should be laid across, over and under such barriers as roads, rivers and streams and other natural or man made barriers.
- b. Determine the conductivity of the wire or cable by connecting telephones, switchboards and/or appropriate meters if needed at various ranges depending on the test item and noting the quality of communications achieved.
- c. Wire or cable will be strung between poles which are 50 meters apart. The correct amount of droop or slack will be left according to the tables in the Technical Manual for the particular test item. The wire or cable will be left in place for a minimum of 3 months during the test season.

The percent of slack will be measured (using the lowest point of wire droop with the pole height and separation distance). This percent of slack will be compared with allowable tolerances listed within the appropriate TM.

d. Check the flexibility of the wire or cable insulation by manually and mechanically reeling and unreeling it and then checking for cracks or breaks. The test item will be spliced, cut and repaired, and installed on telephones, switchboards and terminal boards. Any instances of rigidity, breaking, cracking or deterioration will be noted.

e. Record the following data:

- 1) Reliable range of wire or cable.
- 2) Any instances noted of rigidity, cracking, breaking or difficulty in splicing, repairing or installation.
- 3) Instances of failure to maintain proper slack while strung between poles.
- 4) Length of time wire was laid or strung.
- 5) Ambient temperatures during test period.

6.2.2.2 Telephone, Switchboards, Teletypewriters and Related Items

a. Test the range of the test item by connecting it to a wire or cable line which has a standard field telephone (that has been checked for specified sensitivity) on the opposite end. The length of the line will be increased by 1/4 mile increments until effective communication is lost. Quality of communications will be noted.

b. Have test personnel determine the ability of the various components of switchboards and teletypewriters to function properly under operational conditions. Drops, line packs, switches, keys, lights, audio signals, hand and head sets and test-peculiar items will be checked by installing wire or radio/wire integrated circuits. Calls and messages will be initiated and the equipment monitored to note any malfunctions. Effects of cold and wind will be noted on all equipment with special attention to mouthpieces.

c. Have test personnel check the power supply for telephones, switchboards or teletypewriters, recording the battery voltage at the beginning of the test and at the end. If a specific criteria has been established for length of time a power supply is to provide adequate power, then a record must be maintained of length of time of adequate battery voltage readings.

- NOTE:
1. Test items having power supplied by generators and/or vehicle power sources that require testing of their power supply should utilize the appropriate MTP's for specifics.
 2. A characteristic of batteries is that the open circuit voltage of a battery will not decrease substantially while the battery is discharging. However the load voltage of a battery decreases radically as the battery is discharged.

d. Record the following data:

- 1) Reliable range of test item.

- 2) Quality of communications at various ranges.
- 3) Any malfunctions of parts of test items.
- 4) Any effects of arctic winter environment on test item.
- 5) Battery voltage readings at beginning and end of each test.
- 6) Length of time power supply provides adequate voltage readings as prescribed by specific criteria.

6.2.2.3 Wire or Cable Reels

- a. Test the reels by dispensing and reeling in the proper wire or cable, meant to be used with a particular reel, by personnel on foot, in wheeled vehicles, tracked vehicles, fixed or rotary winged aircraft or by other appropriate means.
- b. Record any problems encountered with mechanical malfunctions or operational failures due to the arctic winter environment.
- c. Record the following data:
 - 1) Any mechanical failures of the reels.
 - 2) Any problems encountered in dispensing or picking up wire or cable.
 - 3) Any problems due to the arctic winter environment.

6.2.3 Durability

NOTE: Conduct this subtest concurrently with the operational subtests described in this MTP.

- a. Install wire and cable lines over various terrain to include different types of road crossings. Leave these lines for a minimum of 3 months to determine the effects of the arctic winter environment on the lines. Duration of testing and ambient temperatures will be recorded.
- b. Transport the test items a minimum of 300 miles over primary roads, 200 miles over secondary roads, 100 miles over trails and 100 miles over cross-country terrain in tracked and wheeled vehicles.
- c. Inspect the test item for evidence of damage every 50 miles on primary and secondary roads and every 25 miles on trails and cross-country terrain.
- d. Record the following data:
 - 1) Duration of wire or cable tests
 - 2) Any failures or physical damage
 - 3) Total mileage over each type of terrain
 - 4) Meteorological data

6.2.4 Compatibility

NOTE: Conduct this subtest concurrently with the operational subtests described in this MTP.

- a. Setup a wire (cable) net using two or more test items and other tactical wire equipment which would normally be used with the test item(s).

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Attempts shall be made to establish communications. Any problems encountered with items not functioning properly together shall be recorded.

b. Record the following data:

- 1) Any evidence of incompatibility within the tactical wire net or between items of equipment.
- 2) Ambient temperatures and weather conditions.

6.2.5 Human Factors Evaluation and Safety

- a. Conduct all Human Factors Evaluation and Safety tests in accordance with the applicable sections of MTP 10-4-500.
- b. Conduct these tests concurrently with the operational tests described in this MTP.

6.2.6 Maintenance Evaluation

- a. Conduct all maintenance evaluation tests (maintenance and reliability) in accordance with the applicable sections of MTP 10-4-500.
- b. Conduct these tests concurrently with the operational tests as described in this MTP.

6.3 TEST DATA

Test data shall include all data specified in the individual sub-tests of this MTP.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing, marking for identification and correlation, and grouping the test data according to test title.

Specific instructions for the reduction and presentation of individual test data are outlined in the succeeding paragraphs.

6.4.1 Preoperational Inspection and Physical Characteristics

Preoperational inspection and physical characteristics data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.2 Functional Suitability

Examine the recorded data and evaluate the functional suitability of the test items during use in the arctic environment.

6.4.3 Durability

Examine the recorded data and evaluate it to determine if any physical damage occurred or if the performance of the test item was affected under arctic environmental conditions.

6.4.4 Compatibility

Evaluate how well the test item functions with its related equipment and their components.

6.4.5 Human Factors Evaluation and Safety

Human Factors Evaluation and Safety data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.6 Maintenance Evaluation

Maintenance data shall be reduced and presented in accordance with MTP 10-4-500.

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5 June 1970

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

1. ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP -----	
3. REPORT TITLE U. S. Army Test and Evaluation Command Materiel Test Procedure 6-4-006, Environmental Test Procedure, - "Arctic Environmental Test of Tactical Wire Communications Equipment."			
4. DESCRIPTIVE NOTES (Type of report and, inclusive dates) Final			
5. AUTHOR(S) (First name, middle initial, last name) -----			
6. REPORT DATE 5 June 1970		7a. TOTAL NO. OF PAGES 12	7b. NO. OF REFS 44
8a. CONTRACT OR GRANT NO. DA-18-001-AMC-1045(R)		9a. ORIGINATOR'S REPORT NUMBER(S) MTP 6-4-006	
b. PROJECT NO. AMCR 310-6		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----	
c. d.			
10. DISTRIBUTION STATEMENT This document is subject to special export controls and each transmittal to foreign governments or foreign nationals, -WITH THE EXCEPTION OF AUSTRALIA, CANADA, AND UNITED KINGDOM, -may be made only with prior approval of HQ,USATECOM.			
11. SUPPLEMENTARY NOTES -----		12. SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT This Environmental Test Procedure describes test methods and techniques for evaluating the performance and Characteristics of Tactical Wire Communications Equipment under Arctic Winter Conditions. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), or other appropriate design requirements and specifications.			

DD FORM 1473

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S/N 0101-807-6811

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Security Classification

A-31408

5 June 1970

Security Classification

DD FORM 1 NOV 63 1473 (BACK)

S/N 0101-807-6821

Security Classification

A-31423